

Description

Heat exchanger

- 5 The invention relates to a plate heat exchanger with a heat exchanger block which has a multiplicity of heat exchange passages, the heat exchanger block having mounted upon it a header which extends over at least part of one side of the heat exchanger block and makes
- 10 a flow connection between part of the heat exchange passages and which is provided with a fluid connection, the fluid connection being arranged essentially perpendicularly to that side of the heat exchanger block over which the header extends.
- 15 The heat exchanger block of a plate heat exchanger consists of a plurality of layers of heat exchange passages which are in each case delimited relative to one another by means of separating sheets. Closing
- 20 strips and cover sheets form the outer frame of the heat exchanger block. Within a layer, further separating strips may be provided, which separate the heat exchange passages for different material streams from one another.
- 25 The heat exchanger block, initially consisting of loose components, is then soldered together in a soldering furnace, so that all the components are connected to one another in a leak-tight manner. Subsequently,
- 30 headers, which are provided with a fluid connection, are welded on over the inlet and outlet orifices of the heat exchange passages. Semi-cylindrical shells are conventionally used as headers. The fluid connection is formed by tubular connection pieces which are arranged
- 35 opposite the inlet and outlet orifices in the semi-cylindrical casing of the header. The pipelines for the

fluid streams to be supplied and to be discharged are connected to these tubular connection pieces.

By virtue of a suitable arrangement of separating  
5 strips, plate heat exchangers can be used for the  
simultaneous heat exchange of a large number of fluid  
streams. For each of the fluid streams, corresponding  
headers must then be mounted over respective inlet and  
outlet orifices of the heat exchange passages and be  
10 provided with pipelines. The pipework of the plate heat  
exchanger is in this case highly complex and entails a  
high outlay.

The object of the present invention is to improve a  
15 plate heat exchanger of the type mentioned in the  
introduction.

The plate heat exchanger according to the invention has  
a heat exchanger block with a multiplicity of heat  
20 exchange passages. The heat exchange passages may be  
divided into specific groups, the heat exchange  
passages of a group serving in each case for routing a  
specific fluid stream. Headers are in each case mounted  
over the inlet and outlet orifices into the heat  
25 exchange passages of a group in such a way that a flow  
connection between these passages is made.

The header, sometimes also designated as a collector,  
covers part of one side of the heat exchanger block and  
30 forms with this side a closed-off space into which the  
inlet or outlet orifices of a group of heat exchange  
passages issue. According to the invention, the header  
is provided with a fluid connection which is arranged  
essentially perpendicularly to that side of the heat  
35 exchanger block over which the header extends.

The fluid connection, that is to say the orifice of the header to the pipelines supplying or discharging the respective fluid stream, is arranged in a plane which lies essentially perpendicularly to the plane in which  
5 the corresponding inlet or outlet orifices into the heat exchange passages are located. That is to say, the fluid connection is not located directly opposite the inlet or outlet orifices.

10 By virtue of the design according to the invention of the headers and particularly of the fluid connection, it becomes possible to provide all the fluid connections on two opposite sides of the heat exchanger block. It is often even possible to configure the plate  
15 heat exchanger in such a way that all the fluid connections are located on the same side of the heat exchanger block. The pipelines for supplying and discharging the material streams brought into heat exchange with one another therefore no longer have to  
20 be led around the heat exchanger block in a complicated way. The outlay in terms of pipework is appreciably reduced.

The header according to the invention not only serves  
25 for distributing the supplied fluid stream to the heat exchange passages or for collecting fluid emerging from the heat exchange passages, but also for supplying and discharging the corresponding fluid streams.

30 This double function is taken into account, according to the invention, by the provision, within the header, of means for routing the flow of the fluid supplied or discharged via the fluid connection. For example, the header may have arranged in it a guide sheet which  
35 subdivides the space within the header into a flow region, which preferably serves for supplying and discharging the fluid, and into a distribution region,

in which the flow is calmed and as uniform a distribution as possible of the fluid to the heat exchange passages takes place.

- 5 Preferably, the headers possess a semicircular cross section, in particular semi-cylindrical shells have proved appropriate as headers. In such a header design in the form of a half-shell, the fluid connection is then located within one of the two semicircular base  
10 surfaces. For reasons of strength, it may be advantageous for the other of the base surfaces not to be oriented perpendicularly but, for example, obliquely to the semi-cylindrical casing.
- 15 In the versions used hitherto, the supply and discharge of the fluid streams take place via a tubular connection piece welded to the half-shell which must be provided at this point with a corresponding orifice, although the strength of the half-shell is markedly  
20 weakened thereby. In contrast to this, the fluid connection according to the invention is not located in the semi-cylindrical casing of the header, but in one of the semicircular base surfaces. With wall thicknesses remaining the same, the header according to  
25 the invention therefore has a higher strength than the known headers described above. Conversely, in the case of a predetermined desired strength, a smaller wall thickness can be selected in the design of the header according to the invention, with the result that the  
30 costs are lowered.

One of the main advantages of the invention, to be precise a simplification of the pipework, comes into effect especially when the plate heat exchanger has a  
35 plurality of heat exchanger blocks. For manufacturing reasons, for example because of the size of the soldering furnace, limits are placed on the dimensions

of a heat exchanger block. If greater quantities of fluid are to be heated or cooled, it is necessary for two or more heat exchangers blocks to be arranged in parallel. Hitherto, as described in the introduction, in such a parallel arrangement, each heat exchanger block is provided with the corresponding headers and with the tubular connection pieces welded to them. For each material stream, a collecting line is provided, to which the corresponding tubular connection pieces are connected. The pipework of such plate heat exchangers consequently becomes extremely complicated.

By contrast, according to the invention, the heat exchanger blocks are not connected on the flow side via the tubular connection pieces and the collecting line, but, instead, the fluid connection of the header of a heat exchanger block is connected directly to the fluid connection of the header of an adjacent heat exchanger block. Preferably, the fluid connection extends over the entire cross section of the header and, with the cross section being maintained, is connected to the adjacent header. This results in a continuous header which extends over all the heat exchanger blocks.

Advantageously, in a plate heat exchanger with more than one heat exchanger block, the heat exchanger blocks are arranged, spaced apart, next to one another, so that a gap remains between the heat exchanger blocks. The heat exchanger blocks are connected to one another, as a rule welded to one another, preferably with a spacer being installed. The spacer used may be, for example, a correspondingly shaped sheet or a strip.

It is especially beneficial if the spacer is arranged in the region of the header in such a way that that side of the header which faces the heat exchanger blocks is completely covered by the spacer in the

region of the gap. In this case, the space inside the header is delimited by the header itself, for example a semi-tubular shell, the side walls of the heat exchanger blocks and part of the spacer.

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In the case of the parallel arrangement of a plurality of heat exchanger blocks, it becomes particularly clear that the header according to the invention not only serves for distributing the supplied fluid stream to the heat exchange passages or for collecting the fluid emerging from the heat exchange passages, but also for supplying and discharging the corresponding fluid streams.

15 The invention and further particulars of the invention are explained in more detail below with reference to exemplary embodiments illustrated in the drawings in which:

20 Figures 1 and 2 show in each case a side view of a heat exchanger block with two headers, Figures 3 and 4 show the heat exchanger block with a pipeline piece welded on according to the invention,

25 Figure 5 shows two heat exchanger blocks arranged next to one another for producing a plate heat exchanger according to the invention,

Figure 6 shows a plate heat exchanger according to the invention, and

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Figure 7 shows a side view of the plate heat exchanger according to Figure 6.

Figures 1 and 2 illustrate diagrammatically a plate heat exchanger, such as is also known from the prior art. The plate heat exchanger has a heat exchanger block 1 with a multiplicity of heat exchange passages

which are not shown in the figures for the sake of clarity. The inlet and outlet orifices of a group of heat exchange passages are located in the region 2 on a side wall 3 of the heat exchanger block 1 and in the region 4 on the underside 5 of the heat exchanger block 1, respectively. Semi-cylindrical headers 6, 7 are welded onto the regions 2, 3 having the inlet and outlet orifices.

10 The headers 6, 7 are designed as semi-cylindrical shells with base surfaces 8, 9, 10, 11. Arranged in the headers 6, 7 are guide sheets 23, 24 which subdivide the space within the headers 6, 7 into a flow region 25 and a distribution region 26. The guide sheets 23, 24  
15 are provided with a multiplicity of orifices, so that gas and liquid exchange is possible between the flow region 25 and the distribution region 26.

The connection according to the invention of the pipe-  
20 work to the plate heat exchanger can be seen in Figures 3 and 4. The base surfaces 8, 9 of the semi-cylinders 6, 7, that is to say the side walls of the headers 6, 7, serve as fluid connections for the supply and discharge of the fluid conducted through the heat  
25 exchange passages. The other two base surfaces 10, 11 of the headers 6, 7 are closed. Pipelines 12, 13 are mounted on the base surfaces 8, 9. The pipelines 12, 13 are connected to the headers 6, 7 in a leak-tight manner, so that, for example, an inflowing fluid flows  
30 via the pipeline 12 through the open base surface 8 into the header 6 and is distributed in the header 6 to the corresponding heat exchange passages. In a similar way, after heat exchange, the fluid is discharged again via the header 7 and the pipeline 13..

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The two pipelines 12, 13 are located on the same side of the heat exchanger block 1. The connection of the

heat exchanger and the further pipework are thus easily possible.

- Figure 5 shows an intermediate stage in the production of a plate heat exchanger according to the invention. The heat exchanger blocks 1a, 1b are constructed identically to the heat exchanger block 1 illustrated in Figures 1 and 2.
- 10 The heat exchanger blocks 1a, 1b are first subjected, together with their respective headers 6a, 6b, 7a, 7b, to a leaktightness test and a compressive-strength test. After successful testing, all the base surfaces 8a, 9a, 10a, 11a of the headers 6a and 7a of the heat  
15 exchanger block 1a and the base surfaces 8b, 9b of the headers 6b, 7b of the heat exchanger block 1b are separated. Separation takes place on the two mutually confronting sides of the headers 6a, 6b, 7a, 7b, as illustrated in Figure 5 by broken lines 20, obliquely  
20 to the axis of the semi-cylindrical headers 6a, 7a, 6b, 7b. The base surfaces 8a, 9a of the heat exchanger block 1a are cut off perpendicularly to the axis of the semi-cylindrical headers 6a, 7a.
- 25 The two heat exchanger blocks 1a, 1b are then welded together at their lower end by means of a sheet 16. The U-shaped sheet 16 is fastened to the heat exchanger blocks 1a, 1b in such a way that the base of the U-shaped sheet 16 connects the undersides 5a, 5b of the  
30 two blocks 1a, 1b in such a way that a continuous plane is obtained. In the region of the headers 6a, 6b, the two heat exchanger blocks 1a, 1b are likewise connected to a U-shaped sheet 27, the base of which is located in the drawing plane and extends from the upper edge 21a,  
35 21b of the heat exchanger blocks 1a, 1b as far as the lower edge 22a, 22b of the headers 6a, 6b, at which



edge the semi-cylindrical header casing meets the heat exchanger block 1a, 1b.

Figures 6 and 7 show the finished plate heat exchanger.

5 An adapted intermediate piece 17, 18 in the form of a piece of cake is inserted in each case between the headers 6a, 6b and the headers 7a, 7b of the two heat exchanger blocks 1a, 1b and is welded to the headers 6a, 6b, 7a, 7b and to the U-shaped sheets 16. Pipelines  
10 12, 13 are welded to the base surfaces 8a, 9a of the headers 6a, 7a. The two pipelines 12, 13 are located on the same side of the heat exchanger block 1a. The connection and further pipework of the heat exchanger are thus easily possible.

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During operation, for example, the fluid is supplied via the pipeline 12 and flows into the flow region 25, separated by the guide sheet 23, of the header 6a and, via the connection piece 18 in the form of a piece of  
20 cake, into the flow region 25 of the header 6b. The guide sheets 23 of the two headers 6a, 6b have a multiplicity of orifices, through which the fluid passes into the flow-calmed distribution regions 26. In the distribution regions 26 of the headers 6a, 6b, the  
25 fluid is distributed to the corresponding heat exchange passages of the heat exchanger blocks 1a, 1b.

Similarly, after heat exchange, the fluid is discharged again via the headers 7a, 7b, together with the  
30 intermediate connection piece 17, and via the pipeline 13. The headers 7a, 7b are likewise subdivided by a guide sheet 24 into a flow-calmed region 26 and a flow region 25. The flow-calmed region 26 in this case serves essentially for collecting and combining the  
35 fluid emerging from the heat exchange passages and the flow region 25 serves for discharging the fluid to the pipeline 13.

Without further elaboration, it is believed that one skilled in the art can, using the preceding description, utilize the present invention to its fullest extent. The preceding preferred specific embodiments are, therefore, to be construed as merely illustrative, and not limitative of the remainder of the disclosure in any way whatsoever.

In the foregoing and in the examples, all temperatures are set forth uncorrected in degrees Celsius and, all parts and percentages are by weight, unless otherwise indicated.

The entire disclosures of all applications, patents and publications, cited herein and of corresponding German application No. 10308015.5, filed February 25, 2003, and European application No. 03012311.1, filed May 28, 2003, are incorporated by reference herein.

The preceding examples can be repeated with similar success by substituting the generically or specifically described reactants and/or operating conditions of this invention for those used in the preceding examples.

From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this invention and, without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions.